Radiosonde intercomparison tests between IMet-1-AB and Sippican Mark 2 radiosondes at the Albuquerque NWS Sounding site

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ABSTRACT

In this report we summarize some of the results of the dual-sounding system experiment using the NSSL InterMet 3050 portable system and the NWS radiosonde station at Albuquerque, NM (Fig 1). This radiosonde system was aquired by NSSL in April 2009, with the objective of evaluating it for possible use in field programs. We obtained approval to carry out the tests from the Shawn Bennett, the MIC of the Albuquerque NWS Office. The dual-sonde balloon flights were carried out starting on the afternoon of July 28th through the morning flight of August 1 2009. Nine flights were carried out. One terminated early due to effects of a mesoscale anvil and possible icing or electrification effects (both sondes failed). The remaining flights provided useful comparison data. The most important finding was that the NWS Sippican radiosondes show lower relative humidity - by about 8%, though this varies with height and with ambient relative humidity. There were negligible temperature variations between the sondes.

Objective of Tests

The Intermet 3050 system, being of quite low cost compared with other radiosonde systems on the market, offers potential advantages for field programs where a network of radiosonde stations might be desired. This was the primary reason the system was being tested. It is necessary that the accuracy of the temperature, humidity and wind data from the IMET-1 sondes be sufficiently close to other widely used radiosondes so that the observations can complement existing radiosonde network measurements.

Details of the Tests

Comparisons between different radiosonde systems is best done via dual-sonde balloon ascents, where both radiosondes are tied to the same ascending balloon. In Albuquerque, 600 gm balloons were used and these were inflated with ~1800 gm weights being used to determine inflation (when balloon liften weights and this shut-off the gas supply). The Sippican balloons were tied above the IMET-1 sondes, with about 5-6 feet of separation between the sondes. About 30m of line separated the balloon from the Sippican sonde, with a parachute being used during all flights.

The extra radiosonde weight on the balloon required an extra 200gm of lift to be added to the balloon via more hydrogen. Despite this, all soundings reached to between the 8 and 10 mb level (above 20mb is considered an acceptably high sounding by NWS).

Although some launches under windy conditions involved the radiosondes narrowly missing surrounding obstructions all were successful. GPS failed during one Sippican sounding while it continued, but degraded, from the IMET sonde. During one flight both sondes failed at ~ 500mb, near the base of a thunderstorm anvil, due to unknown causes.

Most of our IMET soundings involved the IMET-1 AB sondes that have a pressure sensor. Only one launch used the AA sondes - without a pressure sensor.

The signal reception from the Intermet system was more intermittent than that from the NWS system, with signal dropouts occurring on all flights usually starting around 300mb, sometimes only above 200mb. Because of the easterly winds in the stratosphere, signal reception generally improved above 100mb until bursting, leaving a region of very intermittent data between ~ 300-100mb. The distance to the sonde was at this time ~ 50-70km. *BUT SEE NOTE BELOW.*

Summary of Results

Figures 1-7 displays the temperature and humidity profiles for all soundings performed between July 29 00 UTC and Aug 1 12UTC, 2009, along with the relative humidity, temperature and pressure differences after synchronizing both sounding systems using the GPS and the launching time.

In general, good agreement is observed for pressure (±1 hPa) and temperature (±.5 ºC) profiles, which contrast with the relatively large differences in RH throughout the sounding (Fig 1-7). Figs. 8-9 show the average relative humidity and temperature difference profiles, respectively, indicating that the IMet system yields values about 8-10% wetter than the Sippican system between the surface and 200 hPa. The mean temperature differences were very small, generally less than .1˚C at all levels.

FOLLOW-ON TO THE ALBUQUERQUE TEST

The results presented above were based on files that included ~ 1s data from the Intermet system. The METOS system software crashed at the termination of each flight and other files with processed data were not obtained. This problem, together with concerns over the loss of data above 300mb (at ranges considerably less than those informally advertised) led us to visit the Intermet facilities in Grand Rapids, Michigan to determine the source of some of the problems experienced during the Albuquerque tests. Our August 24-25 visit found that the:

a) signal drop-out mostly above 300mb was due to a faulty antenna component. This was discovered by swapping antennas during a radiosonde flight and comparing signal strengths. The replacement of our antenna with another "identical" one dramatically improved the signal strength.

b) system crash on sonde termination was due to several options being selected as default that had not been sufficiently tested. The exact cause is still unclear but our system did not reproduce the fault after these options were deselected.

c) failure of several AA sondes (no pressure sensor) and one AB (with pressure sensor) to give erroneous readings at startup was due to a failure to communicate the calibration coefficients correctly from the radiosonde to the operating system when the radiosonde was turned on. This is an intermittent problem, solution is unclear at the moment, though repeating the startup procedure may be one solution.

Acknowledgements: These tests and the travel costs were funded by NSSL discretionary funds. We thank Shawn Bennett - the Albuquerque MIC, for approving the tests and all members of the upper-air observation team at the Albuquerque NWS Office for their interest and willingness to participate. Dave Rust (NSSL) helped carrying out additional dual-testing with the NSSL upper-air mobile systems, whose results will be reported elsewhere.

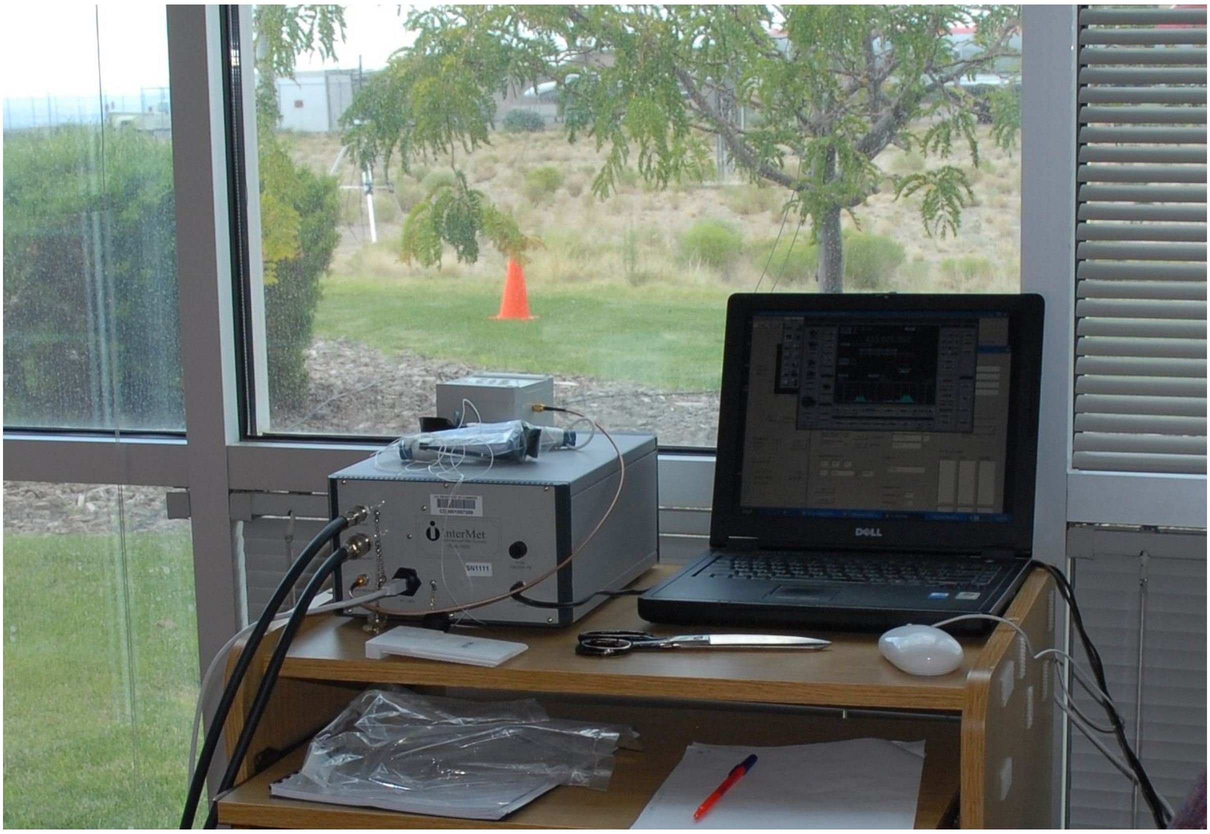
PICTURES

NWS Albuquerque WFO view SE.

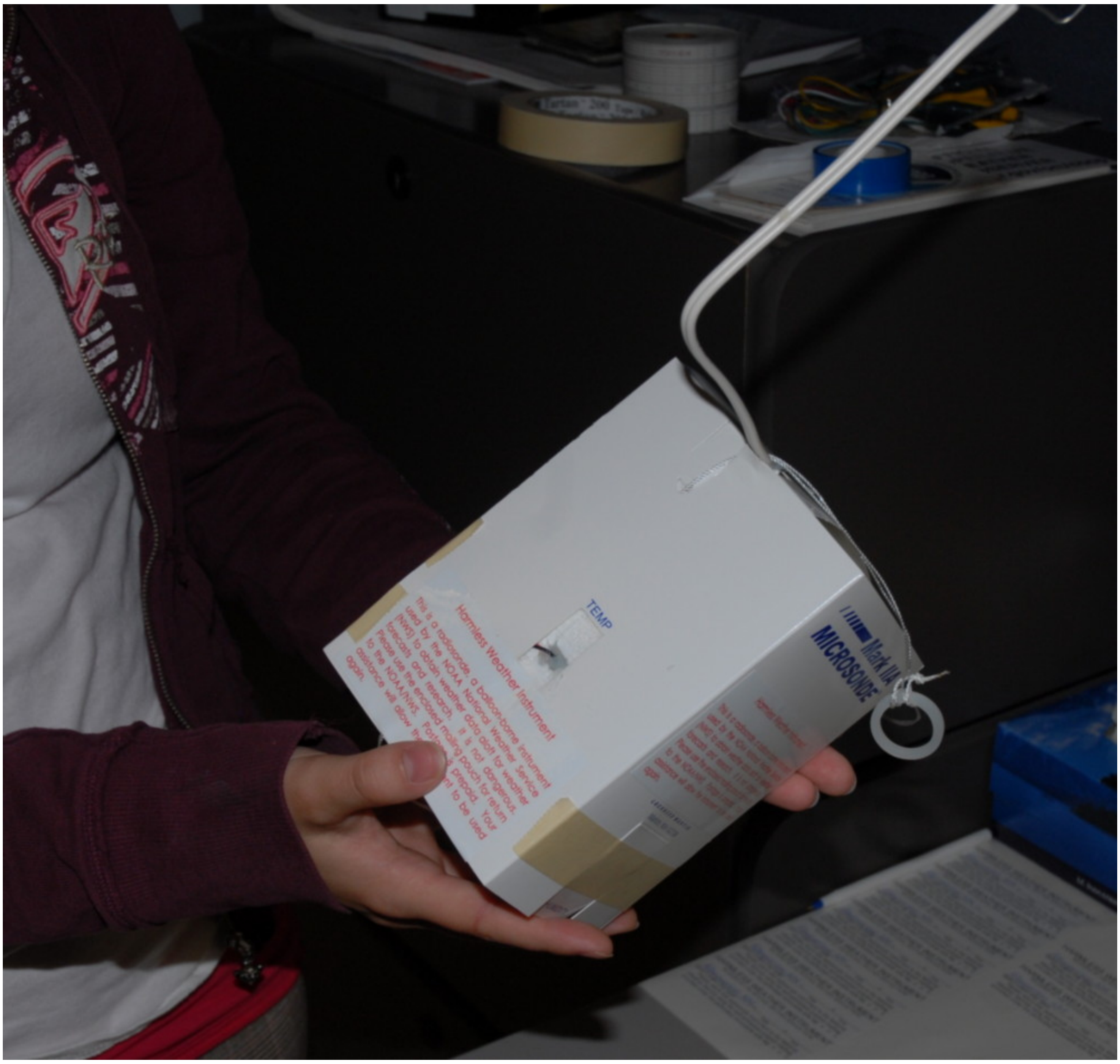
Albuquerque NWS balloon inflation shelter - view towards west from near the IMET antenna.

View looking NNE, showing antenna and local obstructions.

View of tripod and antenna and WFO in background. looking SE.



IMET 3050 set-up inside Albuquerque WFO. Antenna on tripod can be seen in background. Looking NNW.



closer view of Sippican Mark 2a radiosonde, note long boom for T sensor (just out of view)

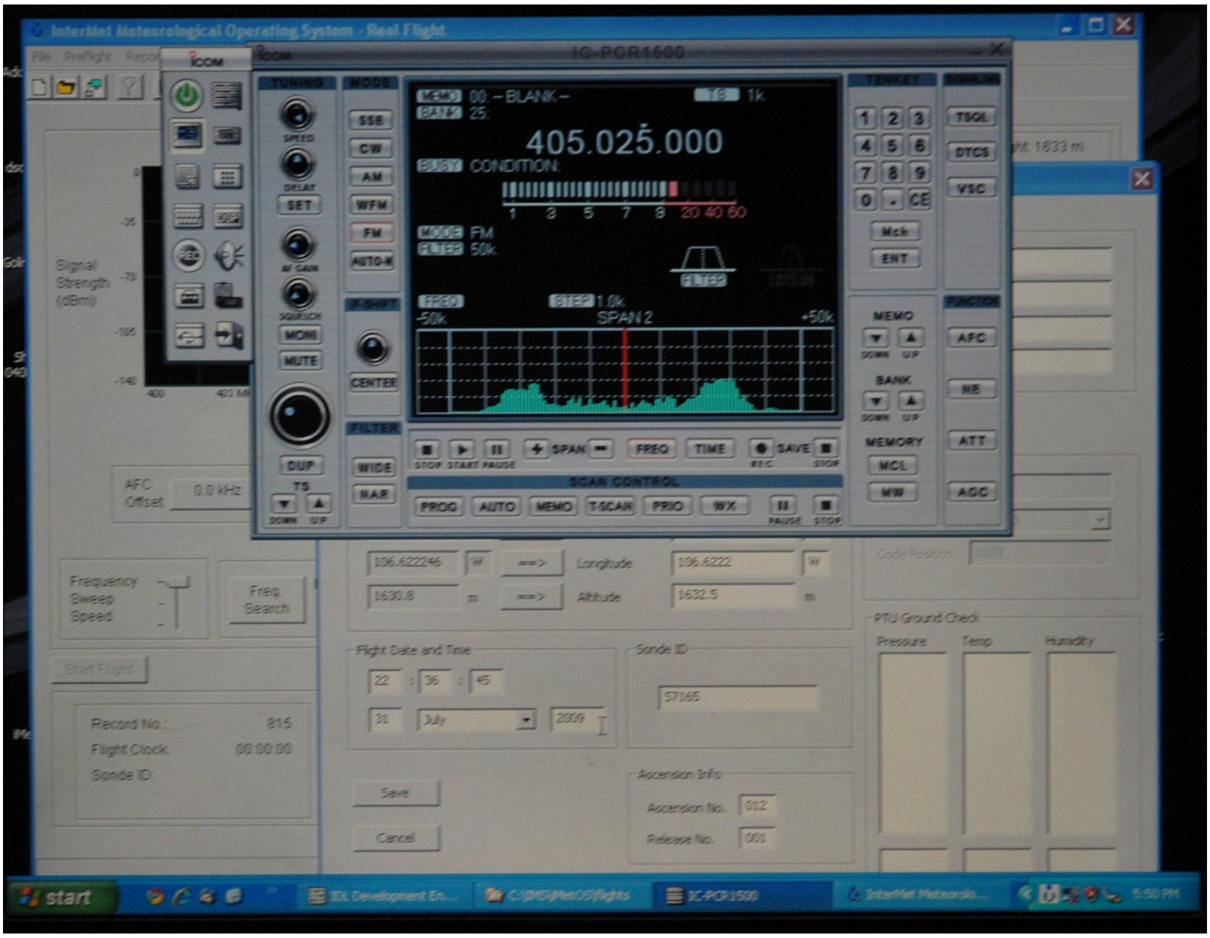
tying IMET radiosonde (not visible) to Sippican sonde. Masking tape was used to make sure motion line connecting IMET sonde (below) to Sippican did not interfer with T sensor boom of Sippican.

Inflation of the balloon and parachute preparation. Balloon inflation system had auto gas cut-off when correct lift was reached.

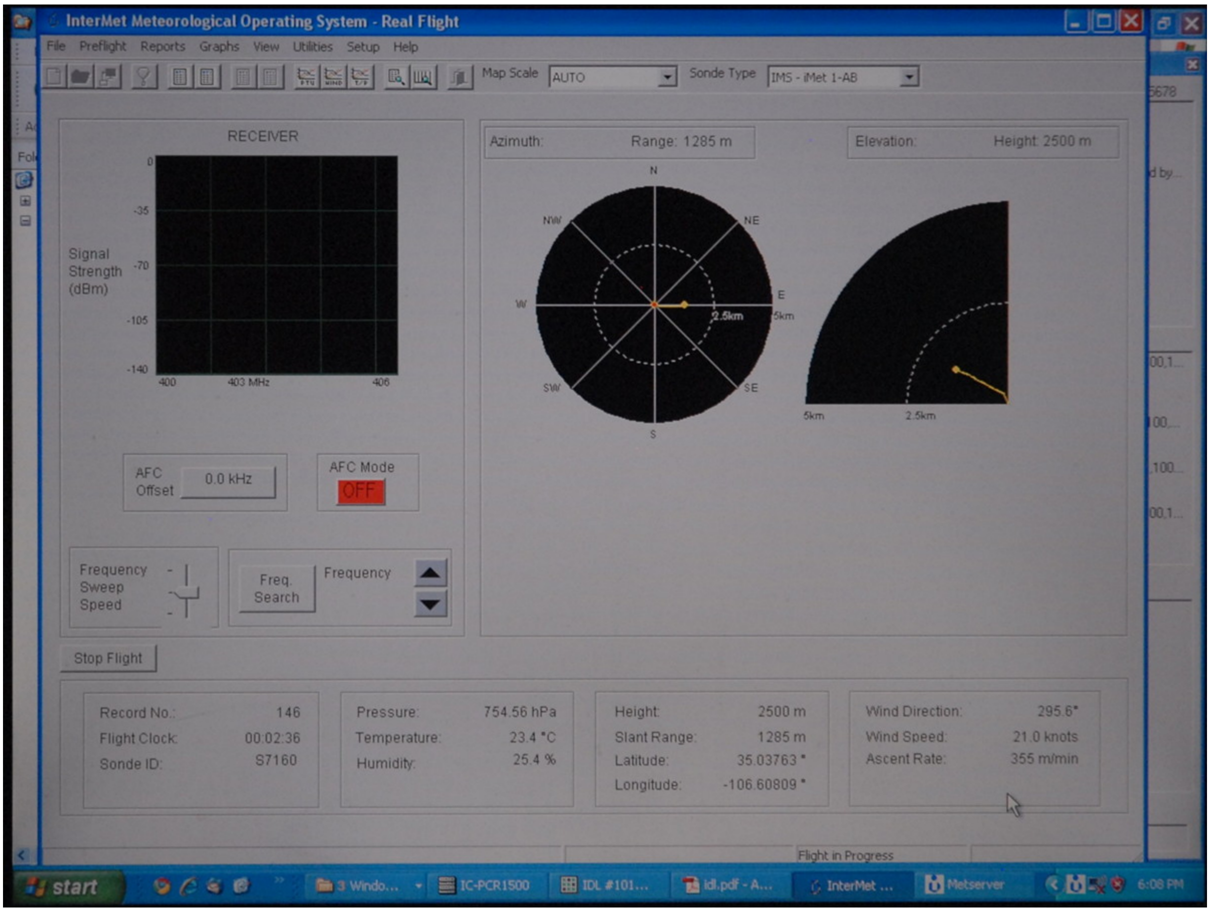
attaching the IMET-1 sonde line to the Sippican sonde

connecting the IMET sonde to the Sippican sonde (left), launching balloon (right)

entire balloon train, with parachute, Sippican MK 2A sonde and at bottom IMET-1 sonde



View of receiver screen showing IMET sonde signal strength before launch.



Example of IMET radiosonde display during flight.

FIGURES

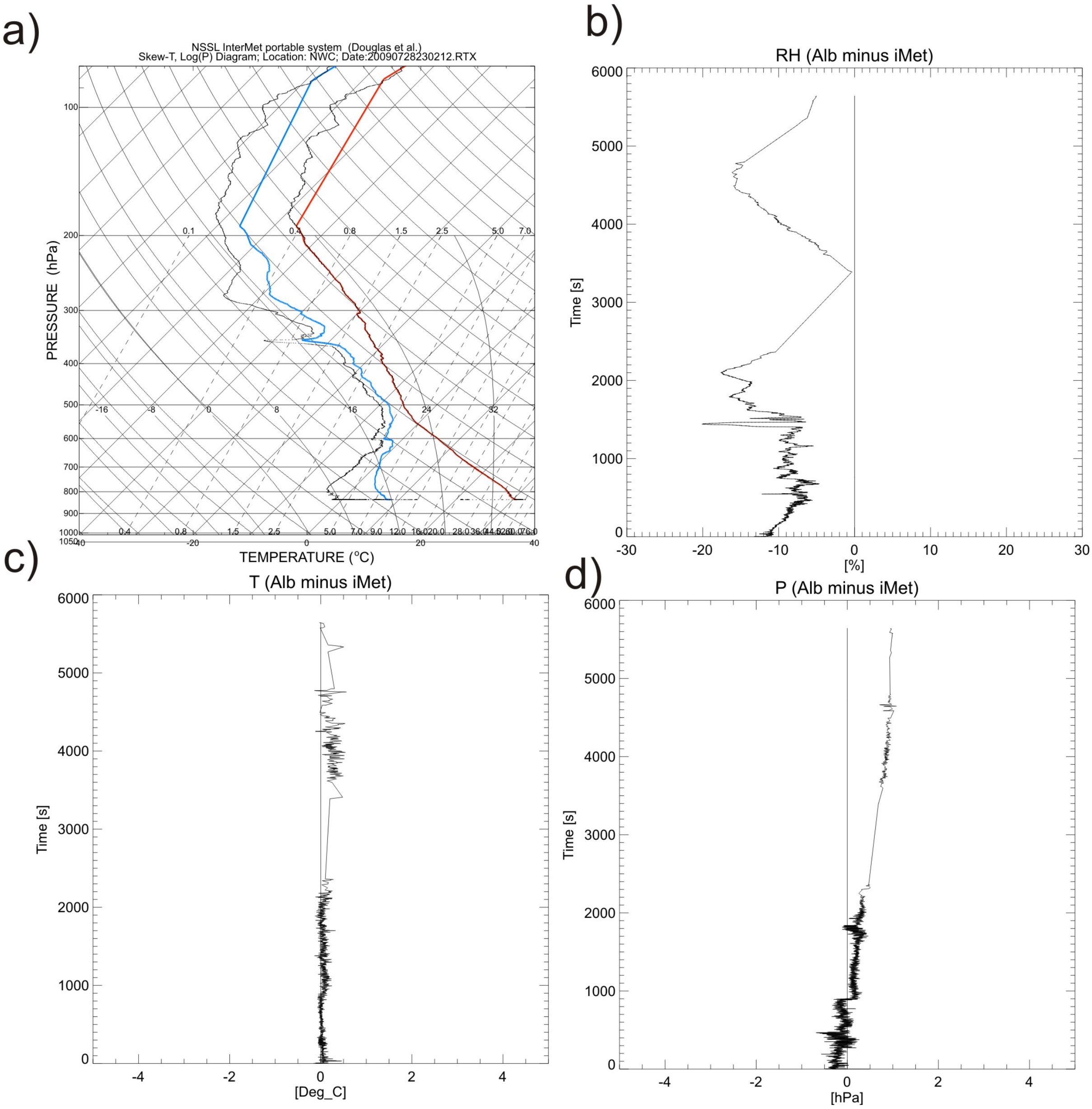


Fig. 1. a) SkewT-logP diagrams for Sipican (broken black lines) and IMet AB (solid colored lines) sounding systems for July 29 00UTC. b), c) and d) panel show the relative humidity [%], temperature [ºC] and pressure [hPa] differences (Sippican minus IMet) for the first 100 minutes after launching.

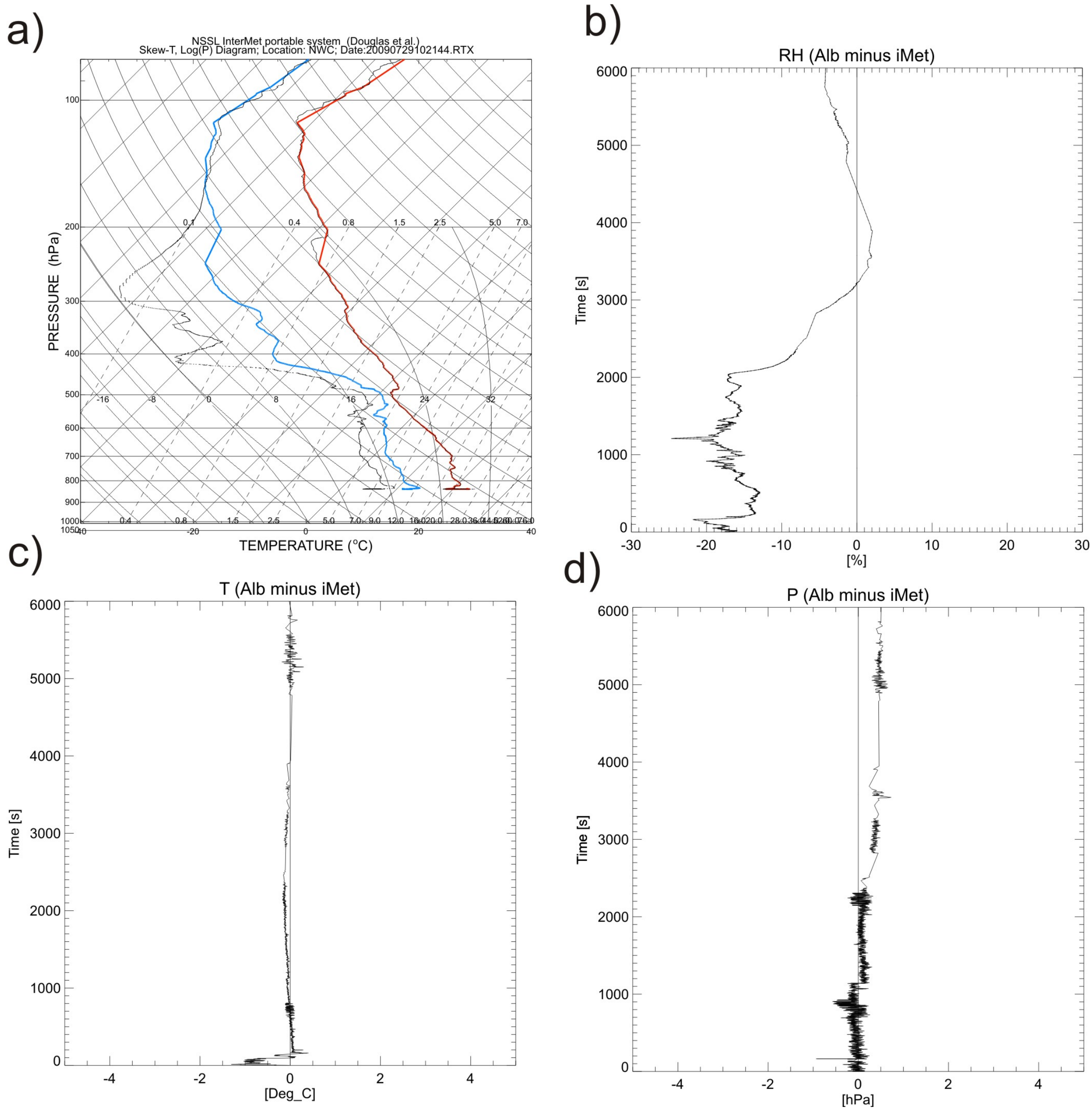


Fig 2. Same as Fig. 1 but for July 29 12UTC.

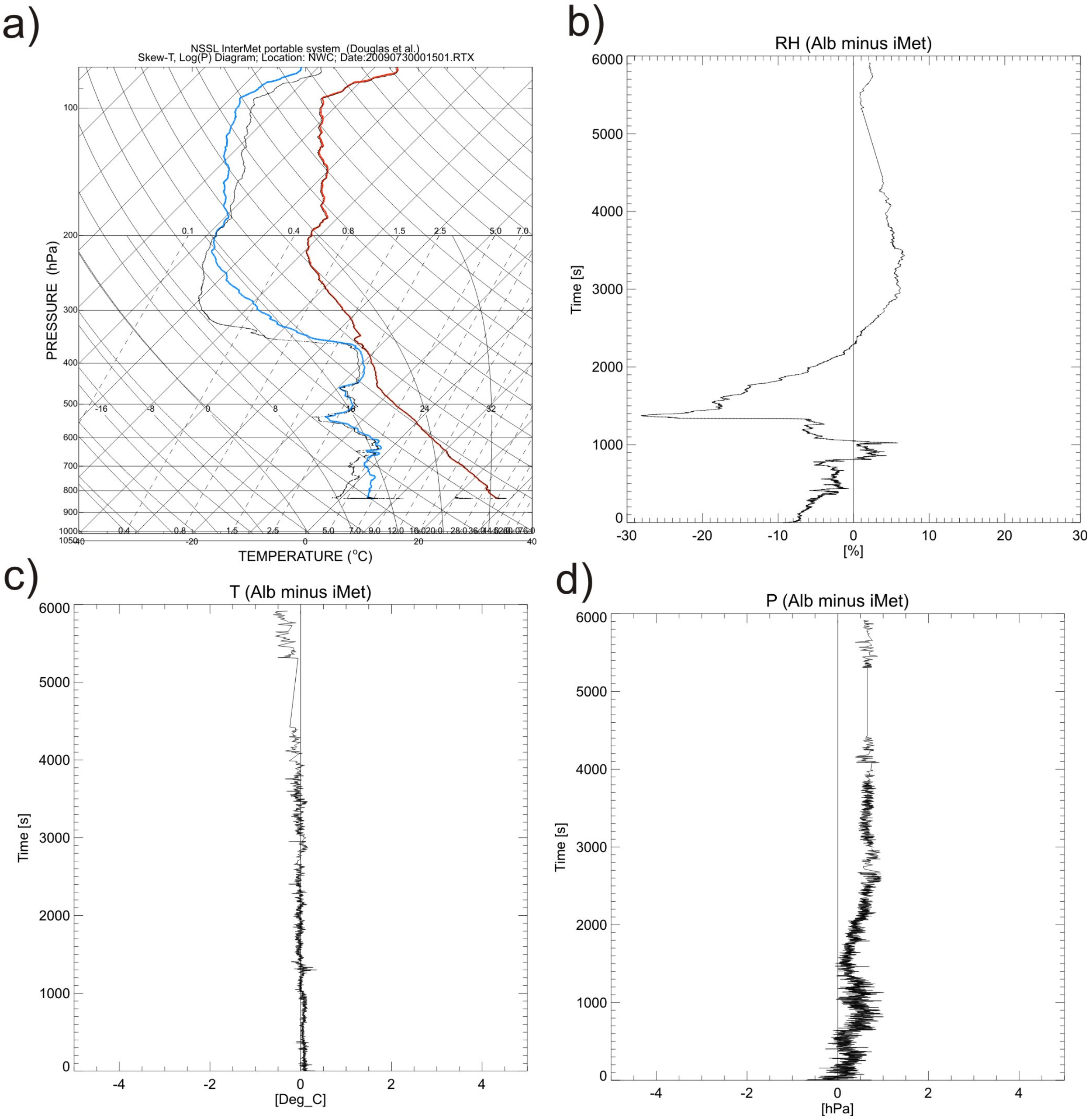


Fig 3. Same as Fig. 1 but for July 30 00UTC.

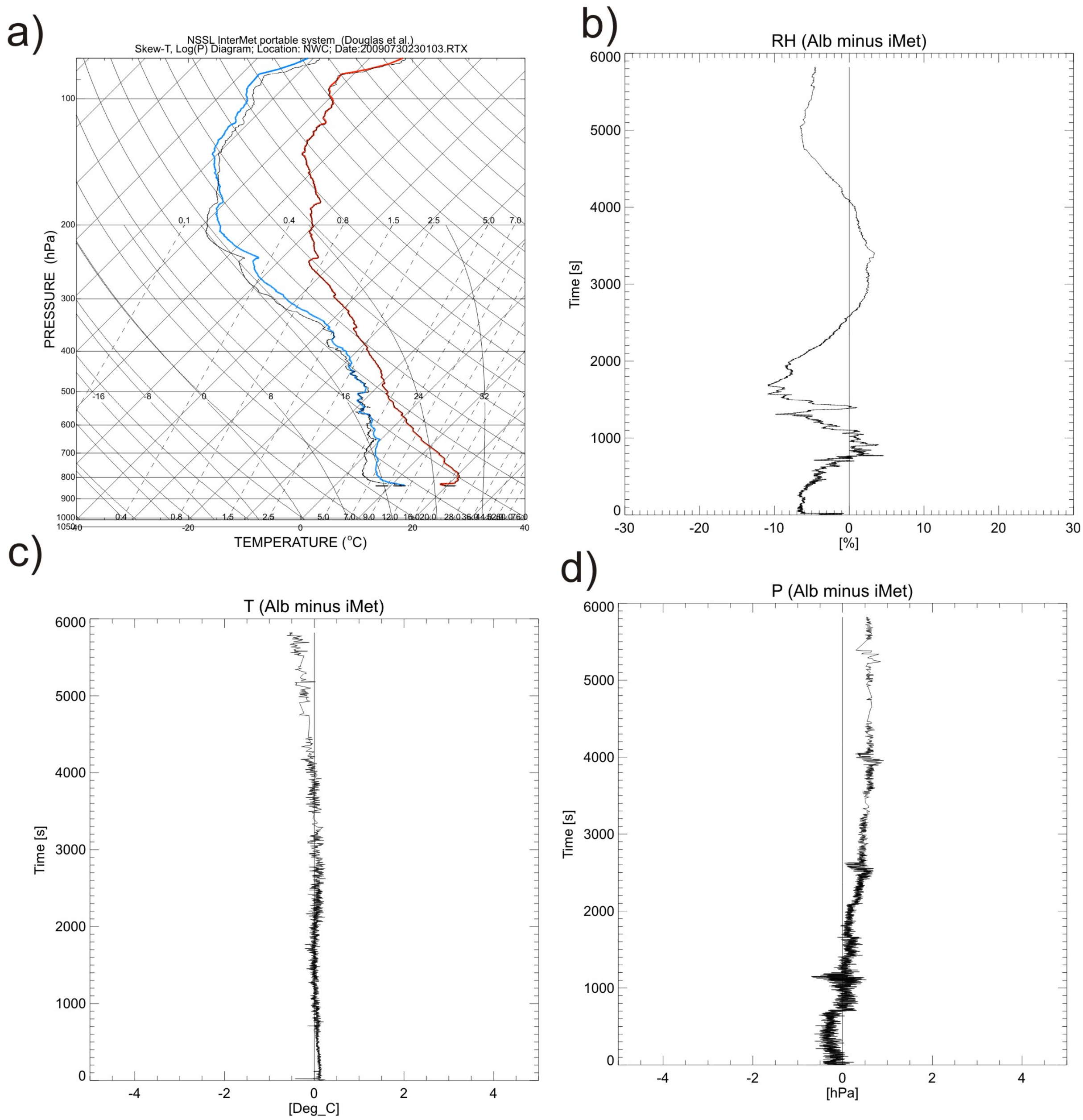


Fig 4. Same as Fig. 1 but for July 30 12UTC.

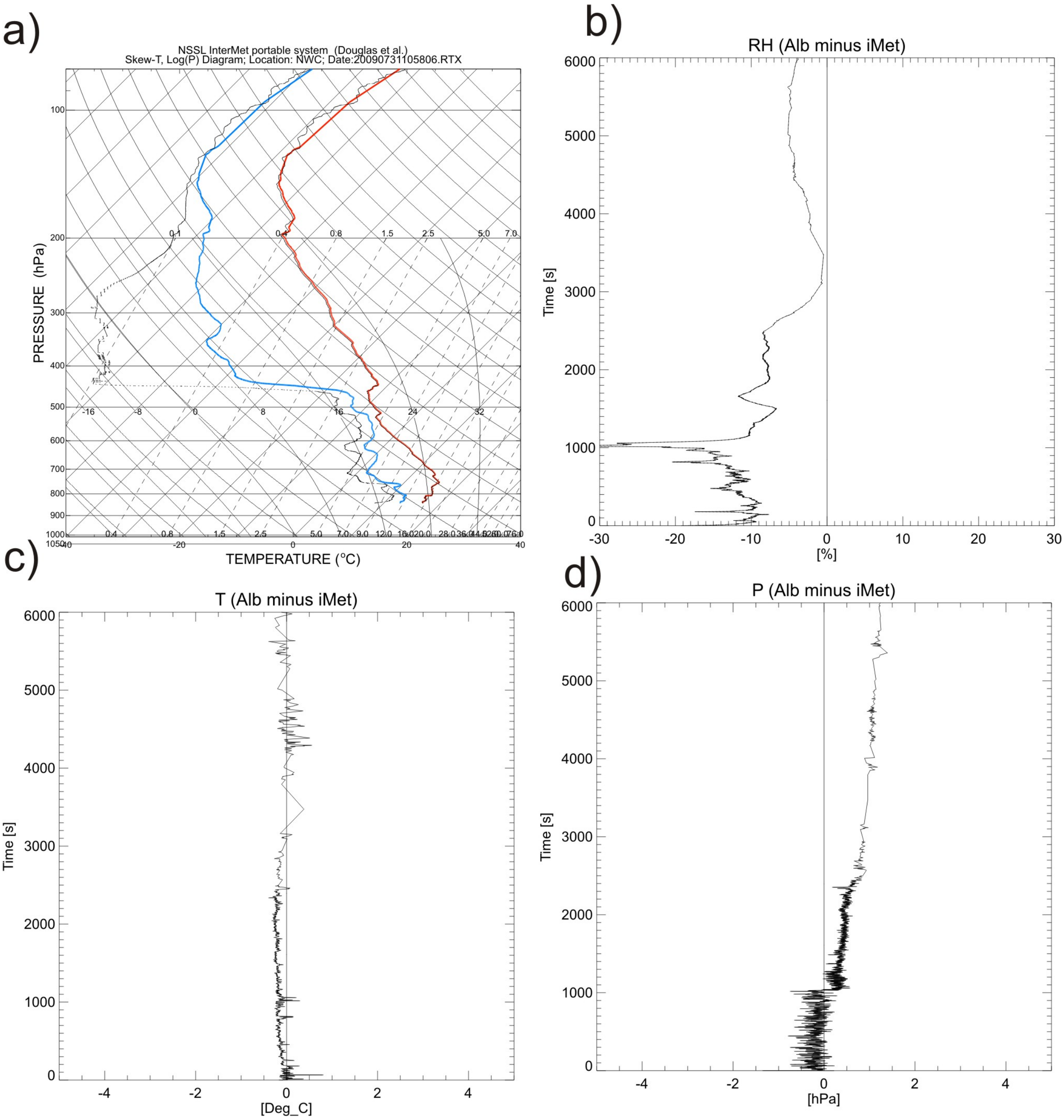


Fig 5. Same as Fig. 1 but for July 31 12UTC.

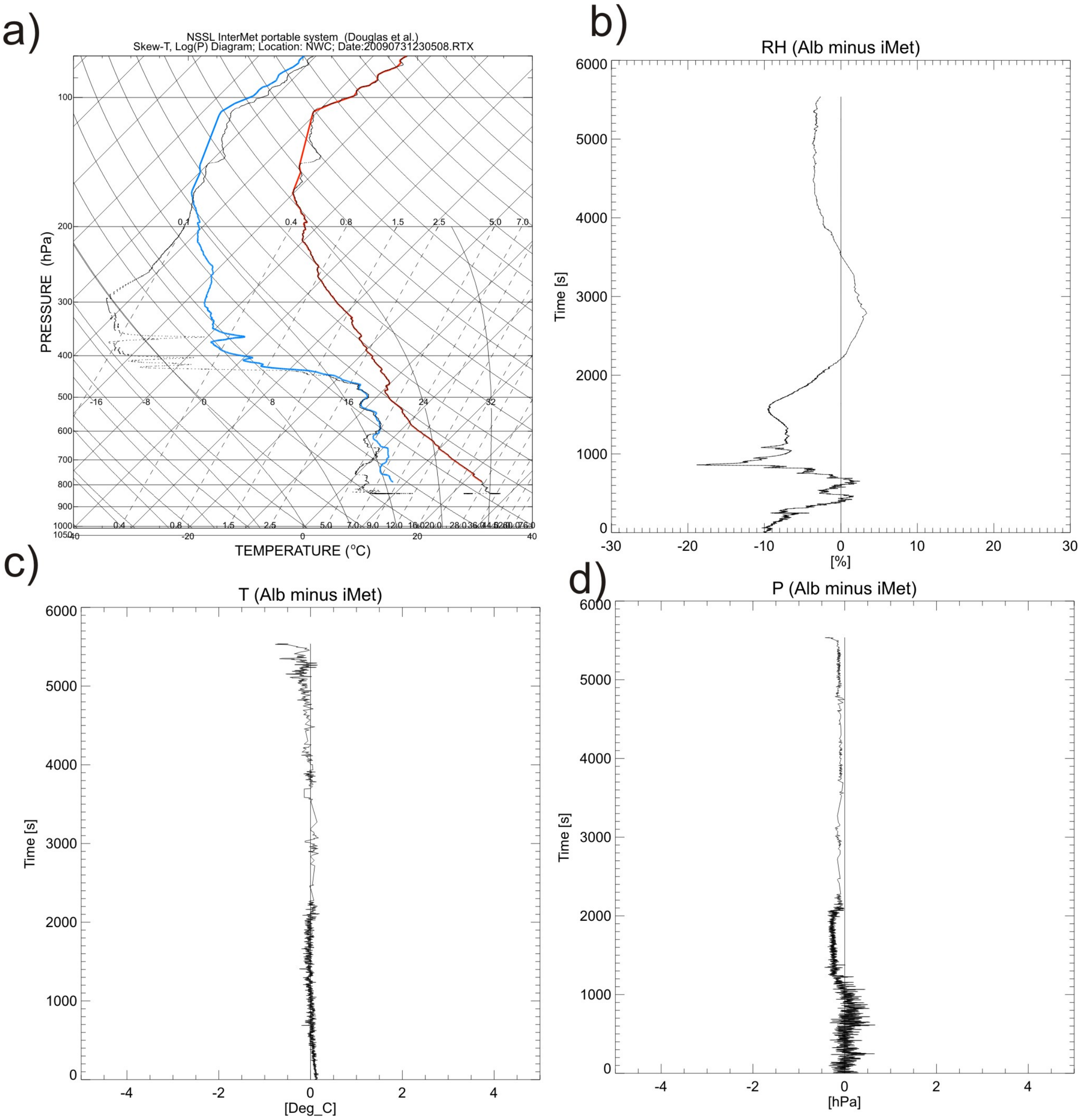


Fig 6. Same as Fig. 1 but for Aug 01 00UTC.

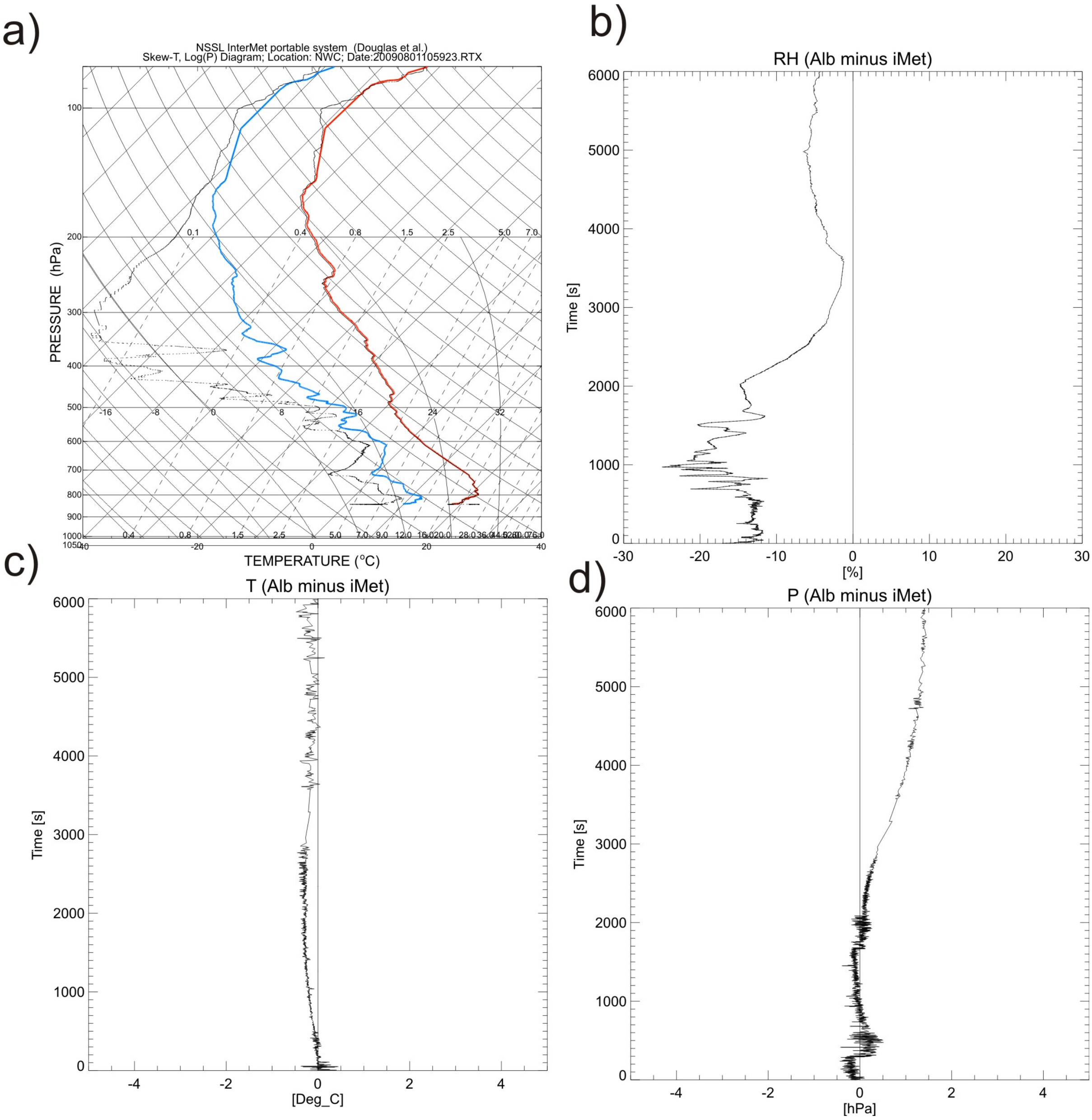


Fig 7. Same as Fig. 1 but for Aug 01 12UTC.

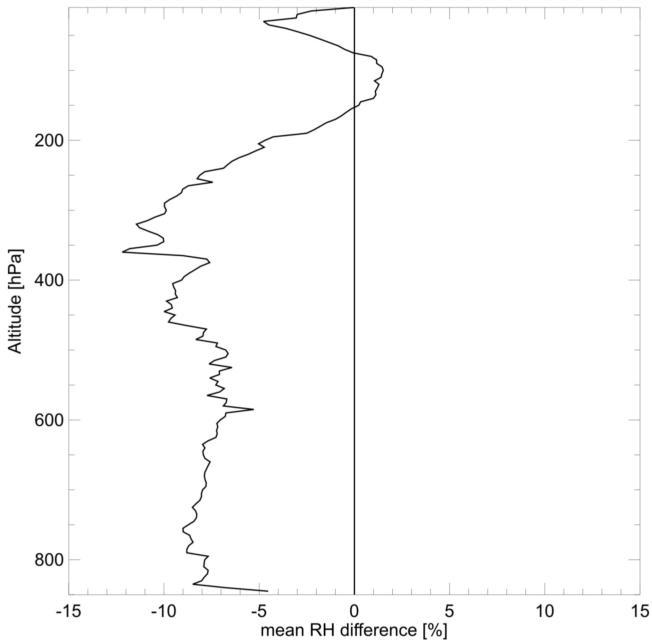


Fig 8. Mean relative humidity differences (Figs, 1-7 (b)) using the pressure profile as reference value for systems every 5 hPa.

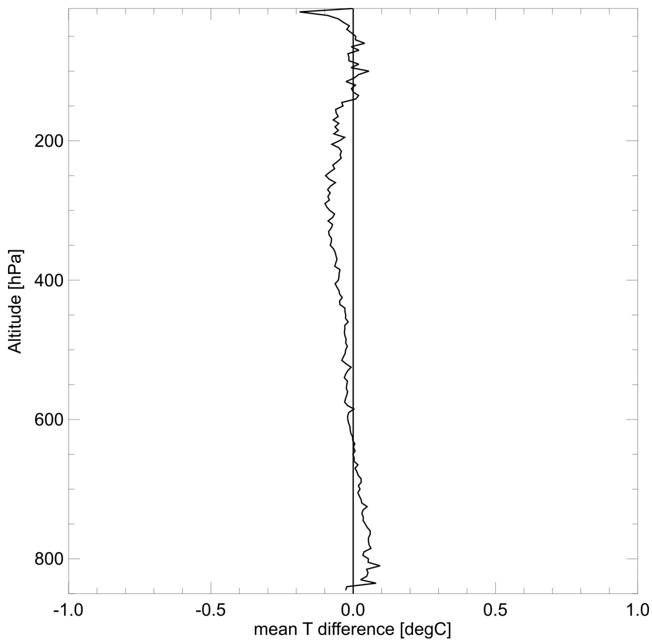


Fig 9. Mean temperature differences (Figs, 1-7 (c)) using the pressure profiles as reference value for both systems every 5 hPa.